IJPSR (2020), Volume 11, Issue 5 (Research Article)

INTERNATIONAL JOURNAL OF PHARMACEUTICAL SCIENCES AND RESEARCH

Received on 03 July 2019; received in revised form, 22 October 2019; accepted, 08 February 2020; published 01 May 2020

PHYTOCHEMICAL ANALYSIS OF LEAVES OF *XYLOSMA LONGIFOLIA* CLOS.: A PLANT OF ETHNOMEDICINAL IMPORTANCE

Rakhi Bhattacharyya [1], Jayanta Sarmah Boruah [2], Krishna Kanta Medhi [*1] and Sarat Borkataki [1]

Department of Botany [1], Nowgong College, Nagaon - 782001, Assam, India.
Material Nanochemistry Laboratory [2], Physical Sciences Division, Institute of Advanced Study in Science and Technology, Paschim Boragaon, Guwahati - 781035, Assam, India.

Keywords:

Xylosma longifolia Clos., Preliminary screening, Quantitative determination, FT-IR, GC-MS analysis

Correspondence to Author:
Dr. Krishna Kanta Medhi

Associate Professor,
Department of Botany,
Nowgong College, Nagaon - 782001, Assam, India.

E-mail: medhikrishnc@gmail.com

ABSTRACT: The present study deals with the phytochemical study of leaves of *Xylosma longifolia* Clos. It belongs to the family Flacourtiaceae and is commonly known as 'Long leaved xylosma', whereas the plant is locally known as '*Kataponial'* in Assam. *Xylosma longifolia* is an important ethnomedicinal plant used in the North-eastern region of India. The aim of the study is to investigate the bioactive compounds present and to evaluate the significance of the therapeutic and pharmacological uses of the phytoconstituents. All the standard phytochemical and spectroscopic procedures were followed for the detection and estimation of the phytoconstituents. The leaves of *Xylosma longifolia* were collected for the preparation of 95% methanol extract. Preliminary phytochemical screening of the methanol extract of *Xylosma longifolia* reveals the occurrence of several secondary metabolites like alkaloids, flavonoids, phenols, tannins, terpenoids and saponins. The quantitative phytochemical analysis exhibited the presence of alkaloids, flavonoids and phenols in considerable quantity. The presence of O-H stretch, C-O stretch, C-H stretch, C-H bend, C=C stretch, N-H stretch and C=O stretch were confirmed through FT-IR analysis. Several major and minor bioactive compounds were identified through GC-MS analysis. From this study, it can be concluded that the ethnomedicinal plant *Xylosma longifolia* contains various bioactive compounds. Further phytochemical and pharmacological studies are an urgent need for the isolation and discovery of some novel drugs to cure several disorders.

INTRODUCTION: Medicinal plants are the mainstay of every traditional or folk medicine. From the beginning of human history, people are exploring plant species in search of therapeutic properties and management of a wide range of infections and ailments [1, 2]. About 350,000 higher plants are estimated to exist, among which very less number of medicinal plants has been studied scientifically [3, 4].

QUICK RESPONSE CODE

DOI: 10.13040/IJPSR.0975-8232.11(5).2065-74

This article can be accessed online on www.ijpsr.com

DOI link: http://dx.doi.org/10.13040/IJPSR.0975-8232.11(5).2065-74

The various parts of medicinal plants like bark, leaves, flowers, fruits, stem, roots, and even the whole plant are used in the treatment of an illness are a rich source of several biologically active components such as alkaloids, flavonoids, phenols, saponins, steroids, tannins and terpenoids [5, 6]. The study of phytochemicals is very important for finding out new sources of ingredients and also for the discovery of some new potential compounds [7].

Xylosma longifolia is a small-sized tree belongs to the family Flacourtiaceae and is distributed throughout in China, North-east India, Pakistan, sub-tropical Himalaya and Vietnam [8-11]. The leaf and stem bark of the plant is known to have important therapeutic uses and are extensively used

for several purposes in the indigenous medicinal system. The plant is highly prescribed for several disorders in the indigenous medicinal system in Assam and Manipur. The plant has been reported for intoxication, liver ailments, ringworm, piles, stomach pain, scabies, acne, gastritis, dysentery, killing lice, dizziness, hoarseness, regulation of blood circulation, insomnia, restlessness, cough, kidney stone, physical injuries, anxiety and also exhibit antispasmodic, anti-oxidant, antifungal or anti-dermatophytic and anti-tubercular properties [9,10, 12-23].

The aim of the study is to investigate the bioactive compounds present in *Xylosma longifolia* and to evaluate the significance of the therapeutic and pharmacological uses of the phytoconstituents present in the plant.

MATERIALS AND METHODS:

Collection of Plant Material: The leaves of *Xylosma longifolia* were collected from different parts of Nagaon district of Assam. The collected plant material of *Xylosma longifolia* was authenticated by the Department of Botany, Nowgong College, Nagaon. The voucher specimen (RBNG-51) in the form of herbarium is maintained (using standard method) in the Botany Department of Nowgong College for future references [24].

Chemicals: In the present study, all the chemicals including the solvents were of analytical grade and are purchased from Sigma Chemical Co. (USA) and Merck Chemical Supplier (India).

Preparation of the Extract: The collected leaves of the plant were washed properly. The materials are chopped and dried under shade at room temperature until it is dried completely. The dried samples were powdered using a clean and sterile electric grinder 500 gm of powdered plant material was placed in a conical glass percolator. A sufficient quantity of 95% methanol is added into the percolator so as to allow the powdered plant sample to become thoroughly soaked. After 24 h the percolate was filtered using Whatman's filter paper type 1 and the extraction procedure is repeated three times. The combined methanol filtrates were concentrated in the rotary evaporator and the extract was calculated for the extractive value. The concentrated plant samples were transferred into an airtight glass container and stored at the Department of Botany, Nowgong College, Nagaon, Assam, for further analysis [25].

Preliminary Phytochemical Screening: The methanol extract of *Xylosma longifolia* was subjected to phytochemical analysis to identify the occurrence of alkaloids, flavonoids, phenols, tannins, saponins, steroids, and terpenoids. The existence of the bioactive compounds was determined using standard methods [26-28].

Test for Alkaloids: Mayer's Test: To 1.0 ml of the extract few drops of Mayer's reagent were added and the formation of a white creamy precipitate indicates the occurrence of alkaloids.

Dragendorff's Test: About 1.0 ml of the filtrate was treated with Dragendorff's reagent and the formation of an orange-reddish precipitate indicates the presence of alkaloids.

Test for Flavonoids:

Zinc-Hydrochloride Reduction Test: The filtrate was treated with a mixture of zinc dust followed by concentrated hydrochloric acid. The appearance of a red color indicates the presence of flavonoids.

Shinoda Test: The extract solution was treated with small pieces of magnesium ribbon followed by pouring concentrated hydrochloric acid dropwise and the formation of pink, crimson red or green color indicates the occurrence of flavonoids.

Test for Phenols:

Ferric-Chloride ($FeCl_3$) Test: The extract solution gives blue-green color with the addition of $FeCl_3$ droplets indicates the presence of phenols.

Shinoda Test: To 1.0 ml of the extract solution few fragments of Magnesium ribbons were added and followed by drops of concentrated hydrochloric acid. The appearance of yellowish color indicates the presence of phenols.

Test for Saponins: Foam Test: To 5.0 ml of the extract solution a little quantity of distilled water was added and shaken vigorously. Development of foam indicates the presence of saponins.

Test for Tannins:

Ferric-Chloride ($FeCl_3$) Test: The filtrate was treated with $FeCl_3$ and the formation of dark green color precipitate indicates the presence of tannins.

Gelatin Test: The extract was dissolved in distilled water and 1% solution of gelatin containing 10% sodium chloride was added to it. The appearance of white precipitates indicates the occurrence of phenols.

Test for Steroids and Terpenoids:
Salkowski's Test: To the extract solutions few drops of chloroform and concentrated sulphuric acid were added. Appearance of red color in lower layer indicates the occurrence of steroids whereas yellow color indicates the presence of terpenoids.

Quantitative Analysis:
Estimation of Alkaloid Content: 1.0 mg of the plant extract was dissolved in dimethyl sulphoxide. Followed by the addition of 1.0 ml of 2N hydrochloric acid and then filtered. The reaction mixture was transferred into a separating funnel where 5.0 ml of bromocresol-green solution and 5.0 ml phosphate buffer were added and followed by the addition of chloroform and was shaken vigorously and was collected in a volumetric flask and diluted to the volume with chloroform.

The absorbance of the resulting test and standard solutions were determined at 470 nm against the reagent blank using a UV/Visible spectrophotometer. The total alkaloid content was expressed as mg of atropine equivalents (AE) of the extract [29].

Estimation of Flavonoid Content: The total flavonoid content was measured by the $AlCl_3$ colorimetric assay. To 1.0 ml of the extract 4 ml distilled water was added. To the reaction mixture, 0.30 ml of 5% sodium nitrite was added. And after 5 minutes, it was followed by the addition of 0.30 ml 10% aluminum chloride and after 5 min 2.0 ml of sodium hydroxide (1M) was treated. The reaction mixture was diluted to 10 ml with distilled water. The absorbance of the resulting test solution was determined at 510 nm against the reagent blank using a UV/Visible spectrophotometer. The total flavonoid content was expressed as mg of quercetin equivalents (QE) of the extract [30].

Estimation of Phenol Content: The total phenolic content was measured by the Folin-Ciocalteu assay method. 1.0 ml of the plant extract was mixed with 9.0 ml of distilled water and was followed by treating of 1.0 ml of Folin-Ciocalteu phenol reagent and was shaken properly. After 3 min, 2.0 ml of 20% sodium carbonate solution was added thoroughly. The absorbance of the resulting test solution was determined at 650 nm against the reagent blank using a UV/Visible spectrophotometer after 90 min. The total phenolic content was expressed as mg of catechol equivalents (CE) of the extract [31, 32].

Analysis by Fourier-Transform Infrared Spectroscopy (FT-IR): FT-IR is used to detect the functional group of the phyto-components present in *Xylosma longifolia.* The absorption spectra of methanol extracts were measured between 4000 and 500 cm^{-1} on Alpha FT-IR instrument from Bruker Optics (OPUS 7.5 software) at Department of Chemistry, Nowgong College, Nagaon, Assam.

Analysis by Gas Chromatography-Mass Spectroscopy (GC-MS): The methanol extract of *Xylosma longifolia* was analyzed through GC-MS, performed at Biotech-Park, IIT Campus, Guwahati in Clarus 680 GC & Clarus 600C MS PerkinElmer, USA; with Liquid Autosampler (Turbo mass software). The stationary phase used in a capillary column of 60 metre in length, 0.25 mm diameter and 0.25 µm film thickness having a phase of 5% diphenyl 95% dimethyl polysiloxane (low bleed). Helium gas (99.99%) was used as carrier gas (*i.e.* mobile phase) at a flow rate of 1.0 ml/min. 2.0 µl of the sample was injected in the GCMS through auto-sampler in split mode (split ratio 10:1). Injector temperature was 280 °C and the ion-source temperature was 180 °C. The oven temperature was programmed at 60 °C (for 3 min), with an increase at the rate 5 °C/min to 200 °C (hold for 3 min) and finally an increase at the rate 6 °C/min to 300 °C (hold for 10 min).

The total run time is 51.83 min. Mass Spectra was taken in Electron Impact positive (EI+) mode at 70 eV. A solvent delay of 8 min was there for MS scan. Mass range i.e. m/z range is 40-600 amu.

Identification of the Compounds: Mass spectra were developed with the help of NIST (National Institute of Standards and Technology) library 2008. Spectrum of the unknown as compared with the patterns of the mass spectra and retention indices of the known present in the databases of NIST library 2008.

Statistical Analysis: The experiments were performed three times and the data were reported as the mean ± SD (Standard deviation) of three measurements.

RESULTS AND DISCUSSION: In the following sub-sections, the results obtained from extraction, preliminary phytochemical screening, quantitative determination, FT-IR and GC-MS analysis are presented.

Extractive Value: The color and extractive value of the methanol extract of *Xylosma longifolia* is given in **Table 1**.

TABLE 1: PERCENTAGE YIELD OF METHANOL EXTRACT OF LEAVES OF *XYLOSMA LONGIFOLIA*

Solvent	Part	Color of extract	Yield (% w/w)
Methanol	Leaf	Blackish	3.8

Preliminary Phytochemical Analysis: The preliminary phytochemical analysis of the methanolic extract of leaves of *Xylosma longifolia* showed the presence of secondary metabolites like alkaloids, flavonoids, phenols, tannins, saponins, and terpenoids, whereas, steroids are found to absent **Table 2**.

TABLE 2: PRELIMINARY PHYTOCHEMICAL ANALYSIS OF METHANOL EXTRACT OF LEAVES OF *XYLOSMA LONGIFOLIA*

S. no.	Phytochemicals	Test	Occurrence
1	Alkaloids	Mayer' Test	+
		Dragendorff's Test	+
2	Flavonoids	Zinc-Chloride Test	+
		Shinoda Test	+
3	Phenols	Ferric-Chloride Test	+
		Shinoda Test	-
4	Tannins	Ferric-Chloride Test	-
		Gelatin Test	+
5	Saponins	Foam Test	+
6	Terpenoids	Salkowski's Test	+
7	Steroids	Salkowski's Test	-

+ = Presence of phytoconstituents; − = Absence of phytoconstituents

Quantitative Analysis: From the quantitative analysis of methanol extract of *Xylosma longifolia* the total alkaloid content (44.2 ± 0.8 mg AE/g) was the highest followed by the total phenol content (42.9 ± 2.43 mg CE/g) and total flavonoid content (32.8 ± 0.2 mg QE/g) **Table 3**.

TABLE 3: QUANTITATIVE ESTIMATION OF ALKALOID, FLAVONOID AND PHENOL OF LEAVES OF *XYLOSMA LONGIFOLIA*

Plant name	Total alkaloid content	Total flavonoid content	Total phenol content
Xylosma longifolia	44.2 ± 0.8 mg AE/g	32.8 ± 0.2 mg QE/g	42.9 ± 2.43 mg CE/g

FT-IR Analysis: The IR spectroscopy of *Xylosma longifolia* indicated the occurrence of alcohols, alkanes, alkenes, amines, amides, carbohydrates, carboxylic acid, esters, ethers, and phenols. A broad strong peak at around 3315 cm^{-1} indicates the presence of O-H stretching vibration. N-H stretching vibration may also be present in the system which may be overlapped with the O-H stretching band. Two strong peaks around 2920 cm^{-1} and 2810 cm^{-1} may be assigned to the C-H asymmetric and symmetric stretching vibration respectively. The strong peak near 1665 cm^{-1} indicates the occurrence of C=O stretching vibration.

However, the wavenumber at 1440 cm^{-1} indicated the existence of a C-H bend. The peak obtained at around 1410 cm^{-1} indicates C=C stretching vibration. The strong peak obtained at 1020 cm^{-1} with a shoulder peak near 1120 cm^{-1} indicated the presence of the C-O stretching vibration. The FTIR spectrum of methanol extract of *Xylosma longifolia* is presented in **Table 4** and **Fig. 1**.

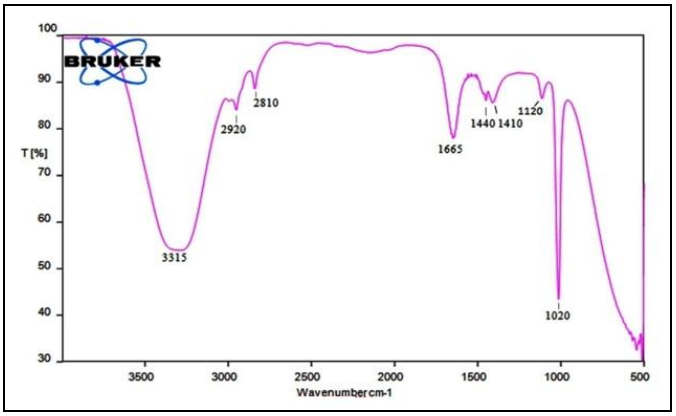

FIG. 1: FTIR SPECTRUM OF METHANOL EXTRACT OF LEAVES OF *XYLOSMA LONGIFOLIA*

The IR spectrum of *Xylosma longifolia* found to have broadband at 3315 cm^{-1} was indicative of O-H stretch which revealed the presence of flavonoids and phenols. The occurrence of phenols is also due to the C-O stretch at 1120 cm^{-1} and 1020 cm^{-1}.

The ester peak for C=O at 1665 cm^{-1} and C-O stretch at 1120 cm^{-1} and 1020 cm^{-1} were due to the presence of terpenoids and steroids. The N-H stretch at 3315 cm^{-1} revealed the occurrence of alkaloids. The terpenes were present with C-H stretch at 2920 cm^{-1} and 2810 cm^{-1}, C-H bend at 1440 $cm^{-1,}$ and C=C stretch at 1410 cm^{-1}. The presence of carbohydrates is considered due to the O-H stretch at 3315 cm^{-1} [2, 33].

TABLE 4: FTIR SPECTRAL WAVE-NUMBER VALUES AND FUNCTIONAL GROUPS OBTAINED FROM THE LEAVES OF *XYLOSMA LONGIFOLIA*

S. no.	Functional groups	Vibrations	Peaks (cm^{-1})
1	Alcohols	O-H stretch	3315
		C-O stretch	1120, 1020
2	Alkanes	C-H stretch	2920, 2810
		C-H bend	1440
3	Alkenes	C=C stretch	1410
4	Amines	N-H stretch	3315
5	Amides	N-H stretch	3315
		C=O stretch	1665
6	Carbohydrates	O-H stretch	3315
7	Carboxylic acid	O-H stretch	3315
		C=O stretch	1665
8	Esters	C=O stretch	1665
9	Ethers	C-O stretch	1120, 1020
10	Phenols	O-H stretch	3315

GC-MS Analysis: Phyto-constituents of *Xylosma longifolia* were analyzed through GC-MS also. The GC-MS analysis of methanol extract of leaves of *Xylosma longifolia* has led to the identification of 12 bioactive compounds having various pharmacological properties. The major compounds identified were L-(+)-Ascorbic acid 2, 6- dihexa-decanoate (16.14%) and N, N-dimethylglycine (13.25 %). The minor compounds with the lowest peak value obtained are 17-Octadecynoic acid (9.0%), n-Hexadecanoic acid (7.53%), 3,7,11,15-Tetramethyl-2-hexadecen-1-ol (6.43%), Phytol (5.70%), Sucrose (4.50%), 9, 12-Octadecadienoic acid (Z,Z)- (4.20%), 3-Heptadecen-5-yne, (Z)- (3.21%), Trichloroacetic acid, tridec-2-ynyl ester (1.99%), Cis-13, 16-docadienoic acid (1.30%) and Cyclododecanol (0.33%). The results are tabulated in **Table 5** and **Fig. 2**.

The mass spectra and molecular structures of the phytoconstituents identified from GC-MS analysis were given in **Fig. 3 - Fig. 14**.

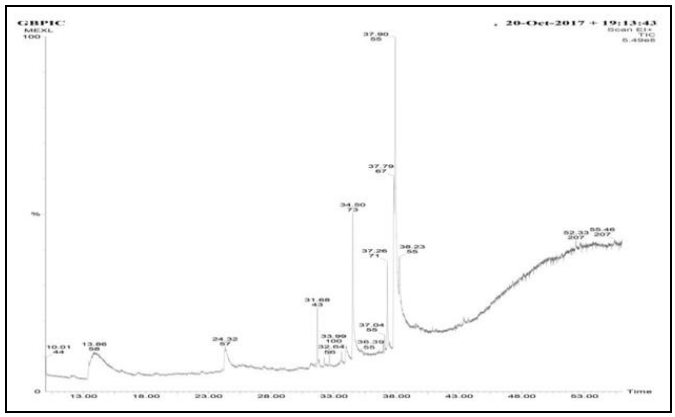

FIG. 2: GC-MS SPECTRUM OF METHANOL EXTRACT OF LEAVES OF *XYLOSMA LONGIFOLIA*

TABLE 5: COMPOUNDS REPORTED IN THE METHANOLIC EXTRACT OF *XYLOSMA LONGIFOLIA* THROUGH GC-MS

S. no.	Retention Time	Name of the compound	Peak area %	Molecular weight	Molecular formula
1	13.86	N,N-dimethylglycine	13.25	103	$C_4H_9O_2N$
2	24.32	Sucrose	4.50	342	$C_{12}H_{22}O_{11}$
3	31.68	3,7,11,15-Tetramethyl-2-hexadecen-1-ol	6.43	296	$C_{20}H_{40}O$
4	32.64	Cyclododecanol	0.33	184	$C_{12}H_{24}O$
5	33.99	3-Heptadecen-5-yne, (Z)-c	3.21	234	$C_{17}H_{30}$
6	34.50	n-Hexadecanoic acid	7.53	256	$C_{16}H_{32}O_2$
7	36.39	Cis-13,16-docasadienoic acid	1.30	336	$C_{22}H_{40}O_2$
8	37.04	Trichloroacetic acid, tridec-2-ynyl ester	1.99	340	$C_{15}H_{23}Cl_3O_2$
9	37.26	Phytol	5.70	296	$C_{20}H_{40}O$
10	37.79	9,12-Octadecadienoic acid (Z,Z)-	4.20	280	$C_{18}H_{32}O_2$
11	37.90	L-(+)- Ascorbic acid 2,6-dihexadecanoate	16.14	652	$C_{38}H_{68}O_8$
12	38.23	17-Octadecynoic acid	9.00	280	$C_{18}H_{32}O_2$

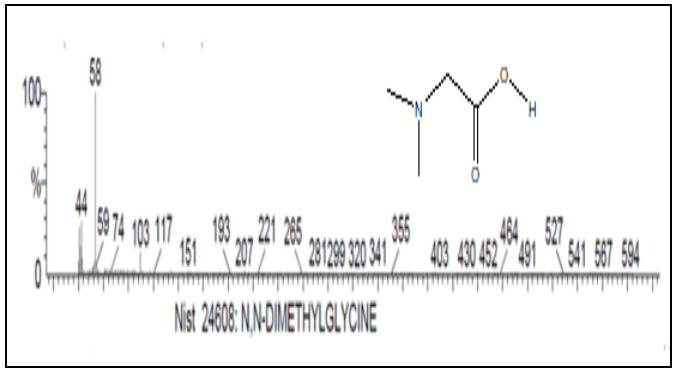

FIG. 3: MASS SPECTRUM AND MOLECULAR STRUCTURE OF N, N-DIMETHYLGLYCINE WITH RETENTION TIME (RT) = 13.86

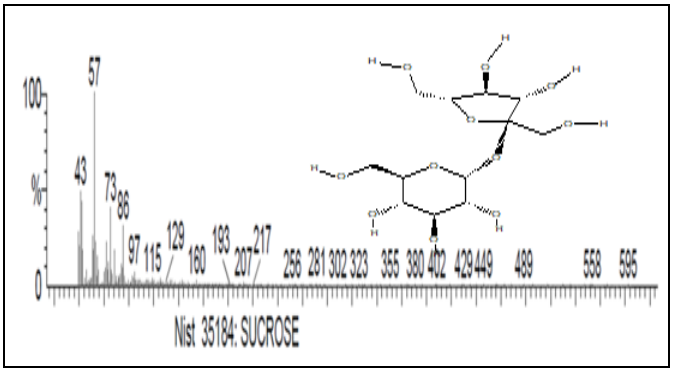

FIG. 4: MASS SPECTRUM AND MOLECULAR STRUCTURE OF SUCROSE WITH RETENTION TIME (RT) = 24.32

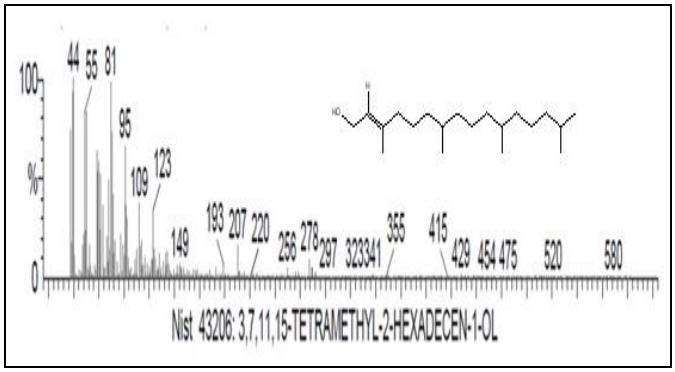

FIG. 5: MASS SPECTRUM AND MOLECULAR STRUCTURE OF 3, 7, 11, 15-TETRAMETHYL-2-HEXADECEN-1-OL WITH RETENTION TIME (RT) = 31.68

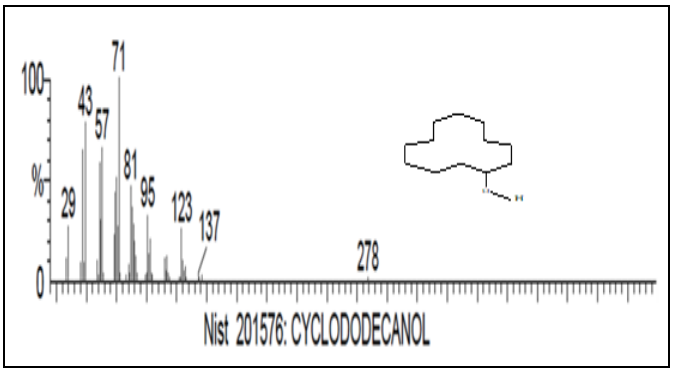

FIG. 6: MASS SPECTRUM AND MOLECULAR STRUCTURE OF CYCLODODECANOL WITH RETENTION TIME (RT) = 32.64

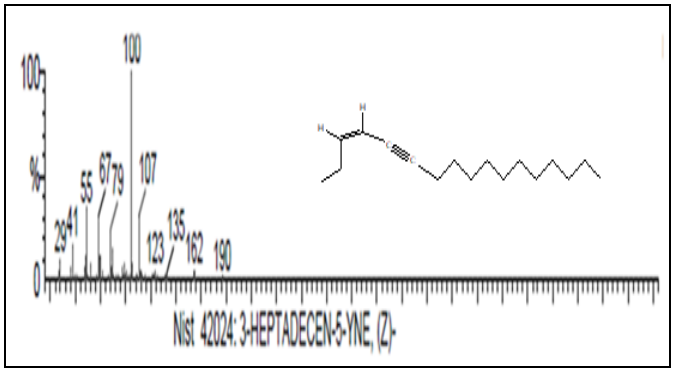

FIG. 7: MASS SPECTRUM AND MOLECULAR STRUCTURE OF 3-HEPTADECEN-5-YNE, (Z)- WITH RETENTION TIME (RT) = 33.99

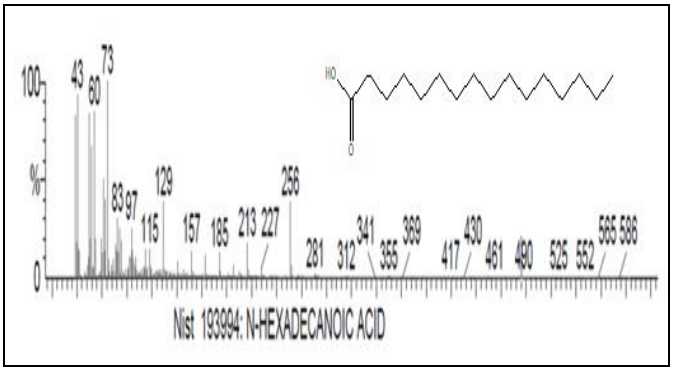

FIG. 8: MASS SPECTRUM AND MOLECULAR STRUCTURE OF N-HEXADECANOIC ACID WITH RETENTION TIME (RT) = 34.50

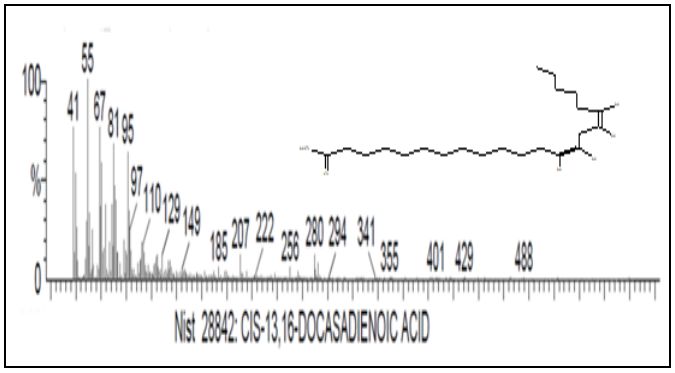

FIG. 9: MASS SPECTRUM AND MOLECULAR STRUCTURE OF CIS-13, 16-DOCASADIENOIC ACID WITH RETENTION TIME (RT) = 36.39

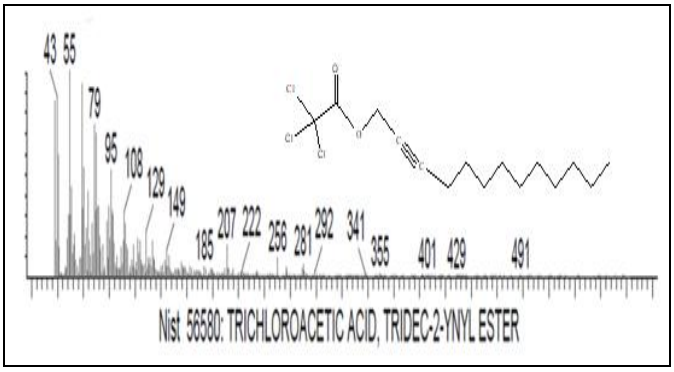

FIG. 10: MASS SPECTRUM AND MOLECULAR STRUCTURE OF TRICHLOROACETIC ACID, TRIDEC-2-YNYL ESTER WITH RETENTION TIME (RT) = 37.04

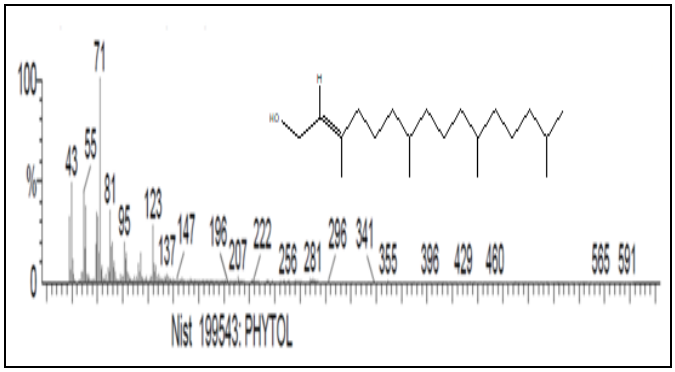

FIG. 11: MASS SPECTRUM AND MOLECULAR STRUCTURE OF PHYTOL WITH RETENTION TIME (RT) = 37.26

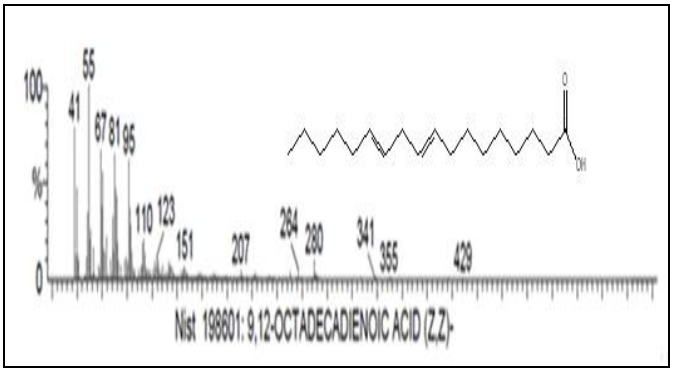

FIG. 12: MASS SPECTRUM AND MOLECULAR STRUCTURE OF 9, 12-OCTADECADIENOIC ACID (Z,Z)- WITH RETENTION TIME (RT) = 37.79

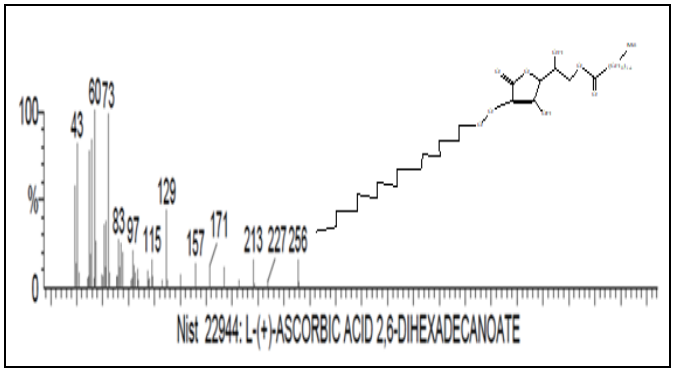

FIG. 13: MASS SPECTRUM AND MOLECULAR STRUCTURE OF L-(+)- ASCORBIC ACID 2,6-DIHEXADECANOATE WITH RETENTION TIME (RT) = 37.90

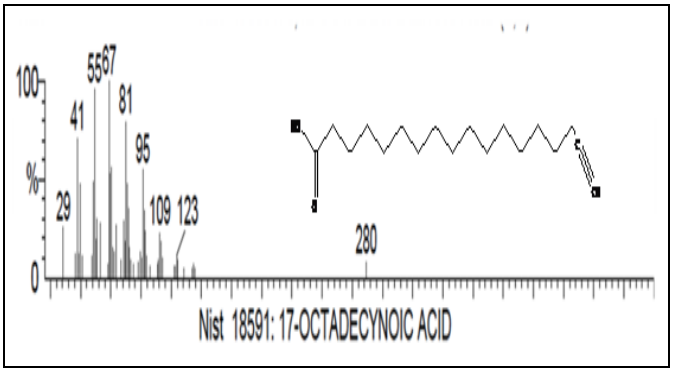

FIG. 14: MASS SPECTRUM AND MOLECULAR STRUCTURE OF 17-OCTADECYNOIC ACID WITH RETENTION TIME (RT) = 38.23

Xylosma longifolia is an important ethnomedicinal plant and have various ethnopharmacological properties used by several tribal communities in the North-eastern and Himalayan region of India. The preliminary phytochemical analysis of the methanolic extract of leaves of *Xylosma longifolia* has shown the occurrence of secondary metabolites like alkaloids, flavonoids, phenols, tannins, saponins and terpenoids, whereas, steroids are found to absent. The IR spectrum of methanol extract of *Xylosma longifolia* has revealed the occurrence of several secondary metabolites like flavonoids, phenols, alkaloids, terpenoids, steroids, terpenes and primary metabolite carbohydrates. A considerable amount of alkaloids, flavonoids and phenols have been estimated by using UV-spectrophotometer. The secondary metabolites are reported to have many pharmacological properties [34-36].

Different classes of alkaloids reported to exhibit several pharmacological activities like antibacterial, cytotoxicity effect, antifungal, antiviral, mutagenic or carcinogenic activity, insecticidal, analgesics, antiseptics, bradycardia, hypotensive, antioxidant, sedative properties, electrolyte transport inhibition, anti-malarial, anti-tumor, anti-inflammatory, Cerebro-protective, mutagenic, anti-cough remedy, hepatoprotective, vaso-relaxing, anxiolytic, immune-regulative, anti-diarrhetic and anti-ulcer effect [37]. Hepatoprotective activity of alkaloid fractions from the ethanol extract of the leaves of *Murraya koenigii* has been evaluated [38]. Antihepatotoxic and hepatoprotective effects of the total alkaloid fraction of leaves of *Hygrophila auriculata* and *Solanum pseudocapsicum* were evaluated and were able to normalize the biochemical levels which were altered due to carbon tetrachloride (CCl_4) intoxication [39,40].

Alkaloids like 6- hydroxyhaemanthamine, heamanthin, lycorine, galanthamine and tazettine have potent antimalarial activity extracted from Amaryllidaceae plants (*Pancratium maritimum*, *Leucojum aestivum*, and *Narcissus tazetta* ssp. *tazetta*) [41]. Alkaloids isolated from *Stephania rotunda* possess antimalarial activity [42].

Flavonoids possess pharmacological properties like anti-oxidant, anti-inflammatory, anti-thrombogenic

activity, anti-tumor, anti-malarial, antiosteoporotic effects, antiviral, antibacterial, antifungal, anticancer, hepatoprotective, free-radical scavenging capacity and coronary heart disease prevention [43, 44]. In-vitro antiplasmodial activity of flavonoids like dehydrosilybinand 8-(1, 1)-DMA-kaempferida has been evaluated against *P. falciparum* strains [45]. Phenolic acids, ellagitannins and tannin-rich fractions of *Punica granatum* L. shows anti-oxidant, anti-malarial and anti-microbial activities [46]. The biological and pharmacological activities of saponins are anti-cancer, antiphlogistic, anti-allergic, immunomodulatory, antihepatotoxic, antiviral, antifungal, anti-inflammatory, hypoglycemic and molluscicidal activities [47].

Several major and minor compounds are identified in the present study through GC-MS possessing many pharmacological properties. N, N-dimethylglycine is also known as dimethylglycine is the athletic performance enhancer, decrease oxidative stress, dietary supplements for patients with Autism, anti-convulsant, anti-depressant, protects the liver, improves immune response and epilepsy [48-50]. The disaccharide sucrose possesses antinociceptive and anti-oxidant properties [51]. Phytol is diterpene alcohol possesses anti-cancer, anti-inflammatory, antimicrobial, antioxidant, diuretic and antinociceptive properties [52, 53]. L-(+)-Ascorbic acid 2,6-dihexadecanoate exhibit antinociceptive, anti-inflammatory and anti-oxidant properties [54, 55]. 3, 7, 11, 15-Tetramethyl-2-hexadecen-1-ol have several biological activities like anti-inflammatory and antimicrobial [56]. N-hexadecanoic acid also known as Palmitic acid possesses 5-alpha reductase inhibitor activities anti-androgenic, antioxidant, hypocholesterolemic, lubricant, hemolytic, flavor, nematicide, pesticide and mosquito larvicide [55, 56].

The 9,12-Octadecadienoic acid (Z,Z)- (Linoleic acid) obtained from the methanol extract exhibit more biological activities like anti-acne, anti-androgenic, anti-arthritic, anti-coronary, anti-eczemic, anti-histamine, anti-inflammatory, cancer preventive, hepatoprotective, hypercholesterolemic, insectifuge, nematicide, and 5-alpha reductase inhibitor [56]. The bioactive compounds present in *Xylosma longifolia* have various pharmacological and therapeutic activities. Further *in-vitro* and *in-vivo* pharmacological investigations on animal models of the phytochemicals isolated from the plant should be prioritized and could lead to the development and discovery of the new potent drug.

CONCLUSION: The preliminary phytochemical screening, quantitative estimation and FT-IR results reveal that the methanolic extract of the leaves of *Xylosma longifolia* consists of various bioactive compounds like alkaloids, flavonoids, phenols, tannins, terpenoids, saponins and carbohydrates. Several major and minor constituents have been analyzed through GC-MS having various pharmacological properties. The result validates the importance and remedial uses of the ethnomedicinal plant *Xylosma longifolia*. Further phytochemical and pharmacological studies are an urgent requirement of *Xylosma longifolia* for identification, isolation and elucidation of the biologically active compounds and for the development of novel potent drugs for curing various disorders.

ACKNOWLEDGEMENT: The first author is greatly thankful to the Head of Chemistry Department, Nowgong College and Coordinator of Institutional Biotech Hub of Gauhati University for providing the laboratory facilities and equipment to conduct the research works. Dr. M.G. Barthakur, Senior Scientist, Biotech Park, IIT Campus (Guwahati) and Dr. Mukul Kalita, Department of Chemistry, Jorhat Engineering College (Jorhat) are gratefully acknowledged for their invaluable support provided in the present research.

CONFLICTS OF INTEREST: The authors declare no conflicts of interest.

REFERENCES:

1. Farnsworth N: The role of ethnopharmacology in drug development. Bioactive compounds from plants. John Wiley and Sons 2008.
2. Maobe AGM and Nyarango MR: Fourier Transformer Infra-Red Spectrophotometer analysis of *Warburgia ugandensis* medicinal herbs used for the treatment of diabetes, malaria and pneumonia in Kisii region, Southwest Kenya. Global Journal of Pharmacology 2013; 7(1): 61-68.
3. Heywood V: Ethnopharmacology, food production, nutrition and biodiversity conservation: towardsa sustainable future for indigenous peoples. Journal of Ethnopharmacology 2011; 137(1): 1-15.
4. Shikov AN, Pozharitskaya ON, Makarov VG, Wagner H, Verpoorte, R and Heinrich M: Medicinal plants of Russian

Pharmacopoeia; their history and applications. Journal of Ethnopharmacology 2014; 154(3): 481-36.
5. Falodun A: Herbal medicine in Africa- distribution, standardization and prospects. Research Journal of Phytochemistry 2010; 4: 154-61.
6. Murugesh S and Vino P: Phytochemical constituents, antioxidant activity and FT-IR analysis of *Pisonia grandis* leaf extracts. International Journal of Pharmacognosy and Phytochemical Research 2017; 9(7): 933-38.
7. Fransworth NR: Biological and phytochemical screening of plants. J of Pharmaceutical Sci 1966; 55(3): 225-76.
8. Vo VC: Dictionary of Vientnamese medicinal plants. Medicine Publishing, Hanoi 1999; 1085.
9. Truong BN, Pham VC, Mai HDT, Nguyen VH, Nguyen MC, Nguyen TH, Zhang H, Fong HHS, Franzblau SG, Soejarto DD and Chau VM: Chemical constituents from Xylosma longifolia and their anti-tubercular activity. Phytochemistry Letters 2011; 4(3): 250-53.
10. Devi WR, Singh SB and Singh CB: Anti-dermatophytic properties leaf and stem bark of *Xylosma longifolium* Clos. BMC Complementary and Alternative Medicine 2013; 13: 155.
11. Sultana S, Ali M and Jameel M: Aliphatic constituents from the leaves of *Dillenia indica* L., *Halothamus bottae* Jaub. and *Xylosma longifolium* Clos. Chemistry Research Journal 2018; 3(3): 109-17.
12. Sinha SC: Medicinal plants of Manipur. Manipur Cultural Integration Conference Publishers 1996.
13. Chadha HR: The wealth of India raw materials. CSIR, New Delhi 2003.
14. Devi AK, Khan MI and Tripathi RS: Ethnomedicinal plants in the sacred groves of Manipur. Indian Journal of Traditional Knowledge 2005; 4(1): 21-32.
15. Khare CP: Indian medicinal plants: an illustrated dictionary. Springer-Verlag, Berlin Heidelberg, New York 2007; 725.
16. Adhikari BS, Babu MM and Saklani PL: Medicinal plants and their conservation status in wildlife institute of India (WII) Campus, Dehradun. Ethnobotanical leaflets 2010; 14: 46-83.
17. Bajpai O, Pandey J and Chaudhary LB: Ethnomedicinal uses of tree species by Tharu tribes in the Himalayan Terai region of India. Research Journal of Medicinal Plant 2016; 10(1): 19-41.
18. Yuhlung CC and Bhattacharyya M: Indigenous medicinal plants used by the Maring tribe of Manipur, Northeast India. J of Ayurvedic and Herbal Med 2016; 2(4): 146-53.
19. Devi WR: Traditional medicinal plants used for various skin diseases and cosmoceuticals in Manipur, North-east India. In Ed Kshetrimayum B. Medicinal plants and its therapeutic uses. OMICS Groups eBook, USA 2017; 21-36.
20. Kom LE, Tilotama K, Singh TD, Rawat AKS and Thokchom DS: Ethnomedicinal plants used by the Kom community of Thayong village, Manipur. Journal of Ayurvedic and Herbal Medicine 2018; 4(4): 171-79.
21. Teron R: Cross-cultural ethnobotanical exploration of diversity and utilization of medicinal plants in Karbi-Anglong district, Assam, Noetheast India. NeBio 2019; 10(1): 35-46.
22. Singh TT, Devi AR and Sharma HM: Ethnopharmacological survey of medicinal plants in Andro village in Manipur (India). Res J of Life Sciences, Bioinformatics, Pharmaceutical and Chemical Sci 2018; 4(5): 606-26.
23. Wiart C: Medicinal plants of Bangladesh and West Bengal: Botany, natural products and ethnopharmacology. CRC Press, Taylor and Francis Group 2019; 103.
24. Jain SK and Rao RR: A handbook of field and herbarium technique. Today and Tomorrow Publication, New Delhi 1977.
25. Handa SS, Khanuja SPS, Longo G and Rakesh DD: Extraction technologies of medicinal and aromatic plants. Trieste: ICS UNIDO 2008.
26. Harborne JB: Phytochemical methods: a guide to modern techniques of plant analysis. Chapman and Hall, London 1984.
27. Trease GE and Evans WC: Pharmacognosy. Balliere Tindall, London, 13th Edition 1989.
28. Sofowara A: Medicinal plants and traditional medicine in Africa. Spectrum Books Ltd, Ibadan, Nigeria 1993.
29. Shamsa F, Monsef H, Ghamooshi R and Verdian-rizi M: Spectrophotometric determination of total alkaloids is some Iranian medicinal plants. Thai Journal of Pharmaceutical Sciences 2008; 32: 17-20.
30. Lobo R, Sodde V and Dashora N: Quantification of flavonoid and phenol content from *Macrosolen parasiticus* (L.) Danser. Journal of Natural Product and Plant Resources 2011; 1(4): 96-99.
31. Singleton VL and Rossi JA: Colorimetry of total phenolics with phosphomolybdic-phosphotungstic acid reagents. American Journal of Enology and Viticulture 1965; 16: 144-58.
32. Malick EP and Singh MB: Plant enzymology and Hittoenzymology. Kalyani Publishers, New Delhi 1980.
33. Ragavendran P, Sophia D, Raj CA and Gpalakrishnan VK: Functional group analysis by FTIR spectrum. Pharmacology Online 2011; 1: 358-64.
34. Vishnu R, Nisha R, Jamuna S and Paulsamy S: Quantification of total phenolics and flavonoids and evaluation of *in-vitro* antioxidant properties of methanolic leaf extract of Tarenna asiatica- an endemic medicinal plant species of Maruthamali hills, Western Ghats, Tamilnadu. Journal of Research in Plant Sciences 2013; 2(2): 196-04.
35. Benedec D, Vlase L, Oniga I, Mot AC, Damian G and Hanganu D: Polyphenolic composition, antioxidant and antibacterial activities for two Romanian subspecies of *Achillea distans* Waldst. et Kit. Ex Wild. Molecules 2013; 18: 8725-39.
36. Senguttuvan J, Paulsamy S and Karthika K: Phytochemical analysis and evaluation of leaf and root parts of the medicinal herb, *Hypochaeris radica* L. for *in-vitro* antioxidant activities. Asian Pacific Journal of Tropical Biomedicine. 2014; 4(S1): S359-S367.
37. Bribi N: Pharmacological activity of alkaloids: A review. Asian Journal of Botany 2018; 1: 1-6.
38. Sangale P and Patil R: Hepatoprotective activity of alkaloid fractions from ethanol extract of *Murraya koienigii* leaves in experimental animals. Journal of Pharmaceutical Sciences and Pharmacology 2010; 3(1): 28-33.
39. Vasanth PR, Raghu HC, Vijayan P, Dhanaraj SA, Mallikarjuna CR, Venkata JR and Nitesh K: *In-vitro* and *in-vivo* hepatoprotective effects of the total alkaloid fraction of *Hygrophila auriculata* leaves. Indian Journal of Pharmacology 2010; 42(2): 99-04.
40. Vijayan P, Prashanth HC, Vijayraj P, Dhanaraj SA, Badami S and Suresh B: Hepatoprotective effects of the alkaloid fraction of *Solanum pseudocapsicum* leaves. Pharmaceutical Biology 2003; 41(6): 443-48.
41. Sener B, Orham L and Satayavivad J: Antimalarial activity screening of some alkaloids and the plant extracts from Amaryllidaceae. Phytotherapy Research 2003; 17(10): 1220-1223.

42. Chea A, Hout S, Bun SS, Tabatadze N, Gasquet M, Azas N, Elias R and Balansard G: Anti-malarial activity of alkaloids isolated from *Stephania rotunda*. Journal of Ethnopharmacology 2007; 112(1): 132-37.
43. Agarwal AD: Pharmacological activities of flavonoids: A review. International Journal of Pharamceutical Scienecs and Nanotechnology 2011; 4(2): 1394-98.
44. Kumar S and Pandey SK: Chemistry and Biological activities of flavonoids: An overview. The Scientific World Journal 2013; 162750.
45. de Monbrison F, Maitrejean M, Latour C, Bugnazet, F, Peyron F, Barron D and Picot S: *In-vitro* antimalarial activity of flavonoid derievatives dehydrosilybin and 8-(1:1)- DMA-Kaempferida. Acta Tropi 2006; 97(1): 102-07
46. Reddy MK, Gupta SK, Jacob MR, Khan SI and Ferreira D: Anti-oxidant, antimalarial and antimicrobial activities of tannin rich- fractions, ellagitannins and phenolic acid from *Punica granatum* L. Planta Medica 2007; 73(5): 461-67.
47. Lacaille-Dubois MA and Wagner H: A review of the biological and pharmacological activities of saponins. Phytomedicine 1996; 2(4): 363-86.
48. Roach E and Carlin L: N,N-Dimethylglycine for epilepsy. New England Journal of Medicine 1982; 307: 1081.
49. Rimland B: Dimethylglycine, a nontoxic metabolite, and autism. Research Review International 1990; 4(3).
50. Bolman WM and Richmond JA: A double-blind, placebo-controlled, cross over pilot trial of low dose dimethyl-glycine in patients with autistic disorder. Journal of Autism and Developmental Disorders 1999; 29(3): 191-94.
51. Gibbins S and Stevens B: Mechanisms of sucrose and non-nutritive sucking in procedural pain management in infants. Pain Research and Management 2001; 6(1): 21-28.
52. Krishnamoorthy K and Subramaniam P: Phytochemical profiling of leaf, stem and tuber parts of *Solena amplexicaulis* (Lam.) Gandhi using GC-MS. International Scholarly Research 2014; 567409.
53. Santos CCMP, Salvadori MS, Mota VG, Costa LM, de Almeida AAC, de Oliveira GAL, Costa JP, de Sousa DP, de Freitas RM and de Almeida RN: Antinociceptive and antioxidant activities of phytol *in-vivo* and *in-vitro* models. Neuroscience Journal 2013; 949452.
54. Bruneton J: Pharmacognosy, Phytochemistry, Medicinal Plants. Lavoisier technique and documentation, Paris 1999.
55. Kumar M, Gayatri N, Sivasudha T and Ruckmani K: Profiling of bioactive components present in *Ziziphus mauritiana* lam for *in-vitro* antioxidant and *in-vivo* anti-inflammatory activities. International Research Journal of Pharmacy 2017; 8(9).
56. Rajalakshmi K and Mohan VR: GC-MS analysis of bioactive components of *Myxopyrum serratum* A.W. Hill (Oleaceae). International Journal of Pharmaceutical Sciences Review and Research 2016; 38(1): 30-35.

How to cite this article:
Bhattacharyya R, Boruah JS, Medhi KK and Borkataki S: Phytochemical analysis of leaves of *Xylosma longifolia* Clos.: a plant of ethnomedicinal importance. Int J Pharm Sci & Res 2020; 11(5): 2065-74. doi: 10.13040/IJPSR.0975-8232.11(5).2065-74.